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THE EYE LENS WEIGHT TECHNIQUE IN AGING OF THE ATLANTIC CROAKER, *MICROPOGON UNDULATUS*

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ABSTRACT The eye lens weight to age relationship was examined in croaker, *Micropogon undulatus.* Lenses were removed, fixed, and weighed using standard techniques. Age estimates were assigned based on total length measurements. Lens weight showed good correlation with total length. Age could be estimated by eye lens weight, but no more accurately or precisely than with length frequency analysis. Cumulative percent frequency analysis of lens weights showed distinct inflections in the curve, which correspond to hypothesized length at age points. The data seem to verify age structure based on length frequency analysis.

INTRODUCTION

The technique of using eye lens weight to determine age has been applied to a wide variety of animals with varying degrees of success. This method was summarized by Friend (1967). The species studied at that time were either mammals or birds. Since 1967 the technique has also been applied to some poikilotherms. The eye lens weight-age relationship was studied in the bullfrog, *Rana catesbeiana,* with some success (Bruggers and Jackson 1974). Freshwater drum, *Aplodinotus grunniens,* and carp, *Cyprinus carpio,* have also been aged using eye lens weight (Burkett and Jackson 1971; Carlton and Jackson 1968). These studies were successful in separating age groups, although overlapping year classes prevented the accurate aging of some individuals.

The Atlantic croaker, *Micropogon undulatus,* is the major component of the industrial bottomfish resource in the north central Gulf of Mexico and is, consequently, of considerable interest to resource stock assessment investigators. The occurrence and life history of the species has been discussed by several authors: Pearson (1928), Gunter (1945), and White and Crittendon (1976). I investigated the age-eye lens weight relationship in croaker to determine what relationship exists and whether this might strengthen the hypothesized age structure based on scale sculpturing and length frequency studies. Conventional scale and otolith reading methods have been moderately successful, but unverified. Well defined scale markings are present, but their interpretation is difficult. Otoliths are brittle and very hard to work with. There are no absolute means of determining the age of individual croaker, except to raise them from the postlarval stage.

MATERIALS AND METHODS

A total of 105 specimens were collected between September 15, 1976 and December 13, 1976, from industrial landings in Biloxi, Mississippi, from hook and line fish caught near the mouth of the Pascagoula River, and from catches southwest of the Mississippi River Delta by the NOAA research ship OREGON II. Individuals were selected from throughout the size range encountered. The selected commercially caught fish were removed from the conveyor as the boats unloaded and transported immediately to the Pascagoula Laboratory for body length measurement and removal of the eyes. All other specimens were worked up within one hour of capture. Sex was determined initially, but proved to be unimportant and was not noted in later samples. Eyes were placed in 10% formalin. The fixing and drying procedure followed that described by Carlton and Jackson (1968). Lenses were weighed every 36 to 48 hours until weighings differed by 0.2 mg or less. Paired lens weights were averaged and damaged lenses discarded.

Length frequency based formulas (Table 1) were used to assign an age to each individual. No formula was available for fish over 276 mm total length, so the age class 2 formula was applied to individuals larger than this. The data were examined by regression analysis for linearity. A graph of the cumulative percent frequency of lens weights was examined for possible age class boundary distinctions.

RESULTS AND DISCUSSION

Storage time does not seem to affect final lens weight. It has been demonstrated also that neither freezing nor

TABLE 1.

Formulas for computing estimated age at size for 3 age classes (Rohr, personal communication).

Age Class 0	
0–160 mm total length	$\text{Age} = \dfrac{\text{Total length} - 1.7428}{160.74}$
Age Class 1	
161–242 mm total length	$\text{Age} = \dfrac{\text{Total length} - 74.172}{82.021}$
Age Class 2	
242–276 mm total length	$\text{Age} = \dfrac{\text{Total length} - 181.92}{31.297}$

chilling have any effect on final lens weight (Longhurst 1964). Data from commercially caught fish can therefore be considered valid despite the lengthy time between death and preservation of the eyes.

Data from all specimens are plotted in Figure 1. No difference in dry lens weight between sexes was observed, so all data were handled in one group. Regression analysis shows a correlation coefficient of 0.9688 for the linear function Y = – 31.5509 + 0.3564 X. The range of lens weight increases with total length, but this can be attributed to normal deviation about the mean, as all data points fall

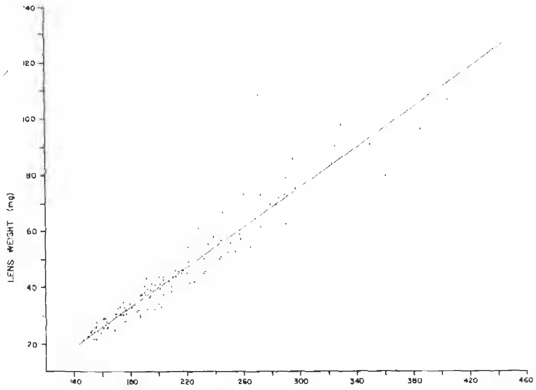

Figure 1. Data from 105 specimens of *Micropogon undulatus*. The solid line corresponds to the formula Y = – 31.5509 + 0.3564 X, Y = lens weight in mg and X = total length in mm. r = 0.9688.

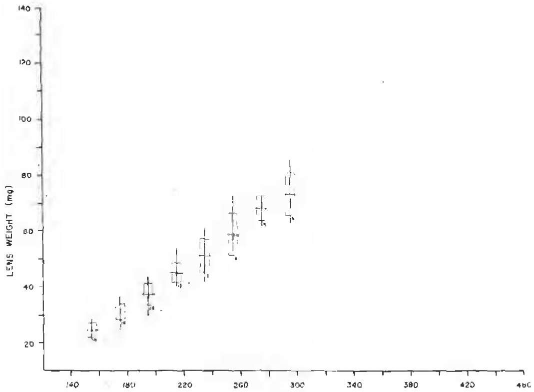

Figure 2. Means for 20 mm size classes. Rectangles indicate ±1 standard deviation while the solid lines represent the range. Numbers refer to sample sizes. In two cases, clumping of data and small sample sizes resulted in one standard deviation above or below the mean exceeding the range of the data. This was the case for size classes at the 255 mm and 275 mm points. Points above 305 mm were not sufficiently abundant for analysis. N = 96.

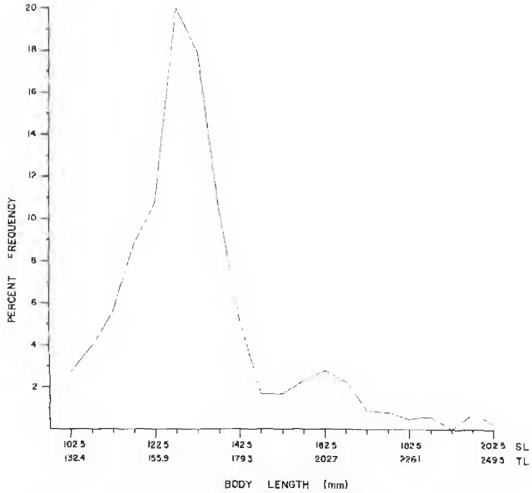

Figure 3. Length frequency distribution in 5 mm groups for November collections in the northern Gulf of Mexico over a 3-year period from 1973 to 1975. Both estuarine and offshore croaker populations were sampled. Original data were taken in the form of standard length measurements as indicated in the upper scale of the abscissa. This was converted to total length as shown in the lower scale for use in developing the length at age formulas. The left peak is age class I; the right peak is age class II. N = 4442 (Rohr, personal communication).

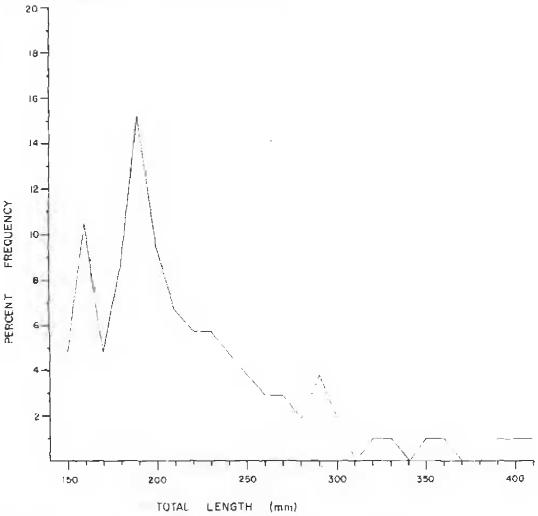

Figure 4. Length frequency distribution in 10 mm groups for croaker used in the eye lens weight investigation. N = 105.

well within two standard deviations of the mean (Figure 2).

The formulas used for age assignment are based on length frequency analysis of estuarine and offshore croaker samples collected over a 3-year period (B. A. Rohr, NMFS,

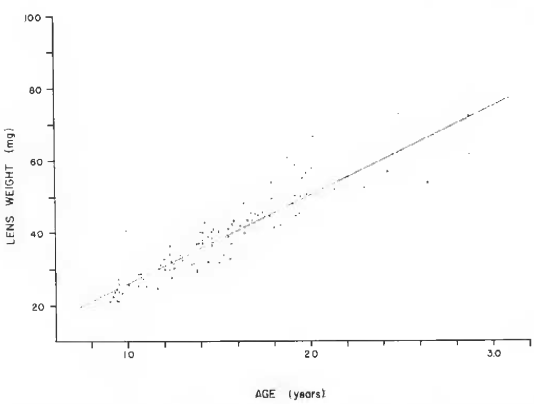

Figure 5. Eye lens weight-age relationship for 90 specimens. The solid line represents the regression formula Y = 1.3563 + 24.4925 X, where Y = lens weight and X = age. r = 0.9109. Data points above the 3.0 year mark were not considered in the regression.

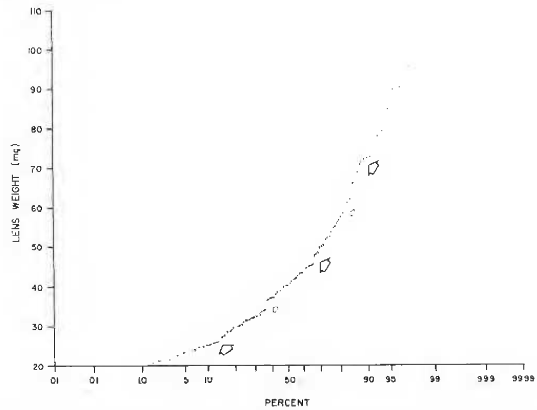

Figure 6. Cumulative percent frequency of eye lens weight. Solid lines represent best fit by visual inspection. Arrows show the major and minor inflection points as discussed in the text. One data point with a lens weight of 132.4 mg was not plotted. N = 104.

SEFC, Pascagoula, Miss). Figure 3 shows the length frequency distribution of this data for November collections. The length frequency distribution of the samples taken for this paper is shown in Figure 4. Even though this was not a random sample, the peaks of the year classes are similar to those in Figure 3. The populations can be considered of similar size and age composition.

Assigned ages are based on total length; therefore, a good lens weight-age relationship is expected. Analysis gave a best fit of the linear form X = Y − 1.3568/24.4925; X and Y representing age in years and lens weight, respectively (Figure 5). This is transformed from the original Y = 1.3568 + 24.4925 X, with a correlation coefficient of 0.9109.

The cumulative percent frequency curve of lens weights exhibits some interesting features (Figure 6). There are three obvious slope changes on this curve. Inflections are seen around the 26–27 mg, 46–48 mg, and 71–73 mg lens weight points. Interestingly, these closely correspond to the 1-, 2-, and 3-year points, respectively (Figure 5). It is difficult to draw definite conclusions from this analysis but age class boundaries are certainly suggested. If these data points are valid, this would verify the hypothesized age structure based on total length frequencies. Lens weight could then be used as an indicator of age in croaker. It should also be noted that there are minor inflection points and breaks in each of the three sections of the curve. In each a slight inflection is accompanied by a 2–3-mg shift in the line, distinguishing, perhaps, between the winter-spring and fall spawned groups of each year class.

Assuming the assigned ages used in this study are valid, age can be predicted from eye lens weight in croaker. Absolute age assignments based on eye lens weight are not possible at this time; however, age class boundaries are suggested. The eye lens technique is involved and time consuming, making it unsuitable for a population monitoring program. However, it does appear to be of value in supporting age assignments by other techniques.

ACKNOWLEDGEMENTS

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LITERATURE CITED

Bruggers, Richard L. & William B. Jackson. 1974. Eye lens weight of the bullfrog (*Rana catesbeiana*) related larval development transformation, and age of adults. *Ohio J. Sci.* 74(5):282–286.

Burkett, R. D. & William B. Jackson. 1971. The eye lens as an age indicator in freshwater drum. *Amer. Nat.* 85:222–225.

Carlton, W. G. & William B. Jackson. 1968. The eye lens as an age indicator in the carp. *Copeia* 1968:633–636.

Friend, M. 1967. A review of research concerning eye lens weight as a criterion of age in animals. *N. Y. Fish and Game Journ.* 14:152–165.

Gunter, G. 1945. Studies on Marine Fishes of Texas. *Pub. Inst. Mar. Sci. Univ. Tex.* 1:1–190.

Longhurst, William M. 1964. Evaluation of the eye lens technique for aging Colombian black-tailed deer. *J. Wildl. Mgmt.* 28(4): 773–784.

Pearson, John C. 1928. Natural history and conservation of the redfish and other commercial Sciaenids on the Texas coast. *Bull. Bur. Comm. Fish.* 44:129–214.

White, M. L. & M. E. Crittendon. 1976. Aspects of the life history of the Atlantic croaker, *Micropogon undulatus*. *Dept. of Wildlife and Fisheries Science* Texas A&M University, College Station, TX 77843.